JitKit

Operator's Manual

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LeCroy Corporation
700 Chestnut Ridge Road
Chestnut Ridge, NY, 10977-6499
Tel: (845) 578-6020, Fax: (845) 578 5985

Internet: www.lecroy.com

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Jitter Kit Overview

LeCroy's Jitter Kit (JITKIT) option makes it simple and easy to understand basic system jitter performance of clock signals or clock-clock and clock- data timing activity. JITKIT is specifically designed for these types of measurements. LeCroy offers other software options for in-depth and comprehensive jitter decomposition and analysis of serial data signals.

Jitter is a deviation in timing, period, width, or amplitude from a “perfect” or a “reference” position(s). By measuring jitter on a clock signal, between clock signals, or between clock and data signals, a value or statistically relevant set of jitter values can be obtained that allow you to understand whether the circuit is operating in its designed range. Jitter is measured as a set of parametric values and viewed in a variety of domains using additional functions. “Jitter” is an all-encompassing term and includes measurements of the following types:

- **Phase (Time Interval Error) Jitter** – clock signal variation referenced to a “perfect” clock
- **Period or Half Period (Width) Jitter** – clock signal variation referenced to a “mean” clock value
- **Cycle-Cycle Jitter** – clock signal variation referenced to the previous clock period (cycle)
- **Timing Jitter** – variation in the timing between two clock or clock and data signals. This could be skew variation or setup/hold timing variations, for instance.
- **Amplitude Jitter** – variation in the amplitude of a signal
- **Other Jitter** – variation in some other parametric value, such as rise time, overshoot, differential crossing point, etc.

Jitter that manifests itself in a phase jitter measurement may not be manifested in a period jitter or cycle-cycle jitter measurement, or vice versa. For instance, modulation in a signal, whether intentional as with spread-spectrum clocking or unintentional due to crosstalk impacts, is easily measured and viewed as phase jitter but is not generally detected as a period measurement. Some circuit effects may be apparent in a half period (width) jitter measurement and not in a full period jitter measurement. Therefore, a means to rapidly switch a jitter analysis setup from one measurement to another is highly desirable for debugging purposes.

Jitter measurements are displayed as a statistical set of values. These measurements may then be viewed in a variety of “domains” to make it easier to understand the characteristics or the root cause of the jitter. LeCroy supports several domain views in JITKIT, as follows:

- **Statistical Domain** – using the Jitter Histogram function/view to display the distribution of values as a histogram display
- **Time Domain** – using the Jitter Track function/view to display each jitter measurement value plotted vertically and time-correlated to the original acquisition
- **Folded Time Domain** – using the Jitter Overlay function/view to display the waveform as a pseudo-eye diagram for the selected jitter parameter.
- **Frequency Domain** – using the Jitter Spectrum function/view to understand the spectral qualities of the jitter to trace it to a cause (e.g. switching power supply noise)

JITKIT (Jitter Kit) is a LeCroy oscilloscope software option. If you have this option, the following topics explain proper usage procedures.

Key Features:

- Jitter Kit provides direct display of jitter measurement values, for both clock signals and clock-clock or clock-data timing.
- Jitter parameter readouts include maximum positive and negative deviations, worst case deviation, peak to peak, and standard deviation on more than 25 jitter related parameters.

- Jitter Kit provides plots which show the time domain, frequency domain and statistical domain views of jitter.
- Time correlated views of input signals and jitter track functions allow easy diagnosis of jitter sources, an overlay view provides an intuitive and accurate view of jitter and how it affects a signal.
- **Quick View** provides an instant setup. This includes four views of jitter and the key jitter parameters.

In the following example, measurement parameters for the Time Interval Error (TIE), Period, and Cycle-to-Cycle period jitter are displayed along with the crossing voltage (Vcross) of the differential input components, frequency, and skew. The measurement table includes the mean value, standard deviation (rms jitter), peak to peak jitter, maximum positive deviation from the mean, maximum negative deviation, and the maximum or worst case deviation. It also reports the number of measurements included in the statistics. The jitter plots shown below include the Jitter Histogram of TIE, the Jitter Track of TIE (which shows TIE as a function of time), the Jitter Spectrum showing the frequency distribution of jitter values, and the Jitter Overlay, which is a persistence display of the input waveform on a cycle by cycle basis.

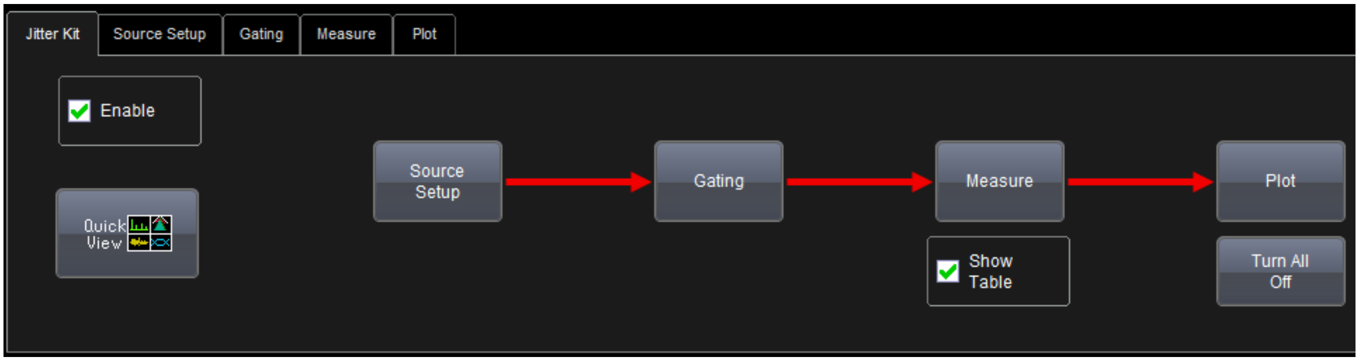
Jitter Kit analysis of a 156.25 MHz differential clock signal including jitter measurements and views of jitter in the time, frequency, and statistical domains plus the jitter overlay

Setting up Jitter Kit

Access the Jitter Kit dialog by choosing **Analysis → Jitter Kit**.

The **Jitter Kit** dialog shows the overall flow for jitter measurement. Each block in the flow diagram is a button that, when touched, displays its corresponding dialog.

> **Example**: Touching the **Source Setup** button displays the **Source Setup** dialog.



Jitter Kit main dialog showing the basic flow of jitter analysis

The main Jitter Kit dialog shows the basic flow of the jitter analysis through a simple block diagram progressing from left to right. Each block in the diagram is also a button. Touching any of the buttons opens its corresponding right hand dialog. Jitter Kit analysis techniques are described in the following topics. The main parts of this flow correspond to the block diagram on the main Jitter Kit dialog.

Use the following steps to start your Jitter Kit setup.

1. If the **Enable** checkbox is unchecked, it turns off all traces and parameters. However, the setup remains in effect. When checked, the traces and parameters remain unchanged.
2. Touch the **Source Setup** button to configure your signal input sources, crossing levels, and signal type.

   > **Note**: Touch the **Quick View** button to quickly set up the four views of jitter and several common jitter parameters.

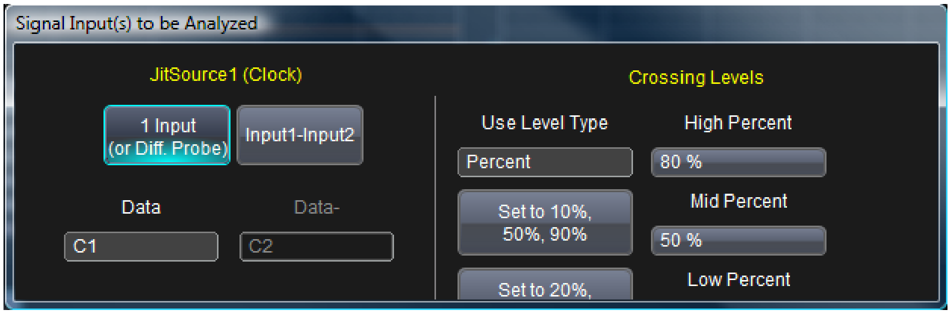
3. Touch the **Gating** button to configure gate types, such as by **Division**, by **Number** of measurements and using **Waveform** gate types.
4. Touch the **Measure** button to select and configure up to 8 measurement parameters.
5. Touch the **Plot** button to configure the Jitter Kit display to show different domain views of the jitter measurements for a single jitter measurement parameter at a time.

Note: Place a checkmark in the **Show Table** box to display statistics below the grid.

Quick View

The Jitter Kit **Quick View** provides an instant setup. This includes the four views of jitter and the key jitter parameters.

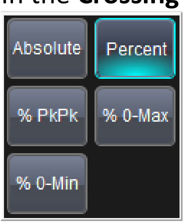
You must specify only the input signal for analysis. You can also specify the crossing level.



Jitter Kit Quick View Signal Input(s) to be Analyzed dialog

Use the following steps for your **Quick View** setup.

1. If you haven't done so already, touch **Analysis → Jitter Kit** on the menu bar.
2. On the **Jitter Kit** dialog, touch the **Quick View** button. The **Signal Input(s) to be Analyzed** pop-up window opens.
3. In the **JitSource1 (Clock)** section, if you are using a differential probe, touch the **1 Input (or Diff. Probe)** button. Now, touch inside the **Data** field below the **1 Input (or Diff. Probe)** button and select an input source from the **Select Source** pop-up window.
   OR
   If you are using two single-ended probes to calculate the differential signal, touch the **Input1-Input2** button. **Input2** is subtracted from **Input1**. Touch inside each **Data** field and select an input source for each from the **Select Source** pop-up window.
4. In the **Crossing Levels** section, choose the **Level Type** from the pop-up menu.

   For example, if you want to set an absolute crossing level, touch inside the **Use Level Type** field and choose **Absolute** from the pop-up menu. Then, touch inside the **Abs Level** data entry field and enter the voltage level at which the signal timing is measured.

   OR

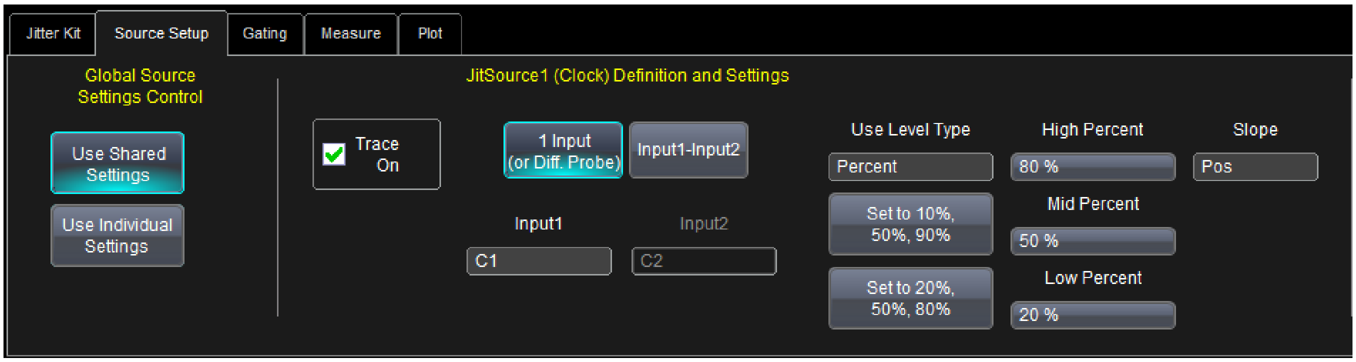
   If you want to use a relative level set to the selected percentage on each acquisition, touch inside the **Use Level Type** field and choose **Percent** from the pop-up menu. Then, you can use the quick buttons below to select commonly used percentage levels, for example, if you selected the **Percent** level type, you can touch the **Set to 10%, 50%, or 90%** button to quickly set the levels or touch the **High**, **Mid** and **Low** buttons to set the levels using your preferred input control method.

6. Click **OK** to view the summary all on one screen.

Jitter Kit Source Setup

Use the Jitter Kit **Source Setup** dialog to set up the jitter source signal(s). The **JitSource1** and **JitSource2** traces are replicas of your channel, but they also have the ability to be easily and automatically time synchronized with the Jitter Track (JitTrack). They also provide the convenience of using two inputs of a differential signal to the oscilloscope and having one trace without needing to separately set up a math function to perform this activity.

You can define shared source settings that apply to all measurement parameters or you can define individual source settings for each measurement. If you choose to define individual source settings, you define the source settings for each separate measurement parameter that you select in the **Measure** dialog.



Jitter Kit Source Setup dialog

Set Up Jitter Sources

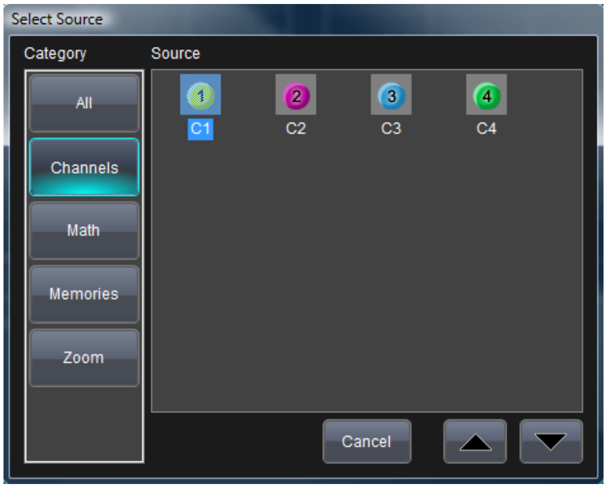
1. Under **Global Source Settings Control**, select a mode:

- **Use Shared Settings** - applies the definitions and settings on this dialog to all measurement parameters.
- **Use Individual Settings** - lets you configure individual settings for each measurement. If you choose to configure individual settings you define the source settings for each separate measurement parameter in the **Measure** dialog.

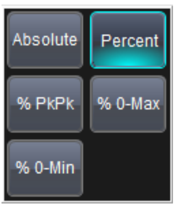
2. For each source, touch the check box next to the **Trace On** field to turn the trace on.
3. In the **JitSource1 (Clock) Definition and Settings** section, if you are using a differential probe, touch the **1 Input (or Diff. Probe)** button. Now, touch inside the **Input1** field below the **1 Input (or Diff. Probe)** button and select an input source from the **Select Source** pop-up window.
   OR
   If you are using two single-ended probes to calculate the differential signal, touch the **Input1-Input2** button. **Input2** is subtracted from **Input1**. Touch inside each **Input** field and select an input source for each from the **Select Source** pop-up window.

> **Note**: If you do use two single-ended input channels on the oscilloscope to acquire a differential signal, be sure to correctly deskew the two inputs prior to using them as an input to **JitSource**.

4. Touch the Input button to select an input from the **Select Source** dialog.



5. Touch the **Use Level Type** to choose a level type from the pop-up menu (**Absolute**, **Percent**, etc.).



For example, if you want to set an absolute crossing level, touch inside the **Use Level Type** field and choose **Absolute** from the pop-up menu. Then, touch inside the **Abs Level** data entry field and enter the voltage level at which the signal timing is measured.

OR

If you want to use a relative level set to the selected percentage on each acquisition, touch inside the **Use Level Type** field and choose **Percent** from the pop-up menu. Then, you can use the quick buttons below to select commonly used percentage levels, for example, if you selected the **Percent** level type, you can touch the **Set to 10%, 50%, or 90%** button to quickly set the levels or touch the **High**, **Mid** and **Low** buttons to set the levels using your preferred input control method.

6. Touch inside the **Slope** data entry control and choose the direction of the voltage transition (**Positive** or **Negative**).

Jitter Kit Gating

Using gates, you can narrow the span of the waveform on which to perform jitter measurements, allowing you to focus on the area of greatest interest. You have the option of dragging the gate posts horizontally along the waveform, or specifying a gate type. There are three gate types:

- **Division** - specify a position down to the hundredths of a division. The default starting positions of the gate posts are 0 div and 10 div, which coincide with the left and right ends of the grid. The gate, therefore, initially encloses the entire waveform.
- **Number** - limit the number of jitter measurement results per acquisition by setting a maximum limit.
- **Waveform** - specify values based on the waveform state (for example, when the waveform state is High or when the level is a specified percentage.

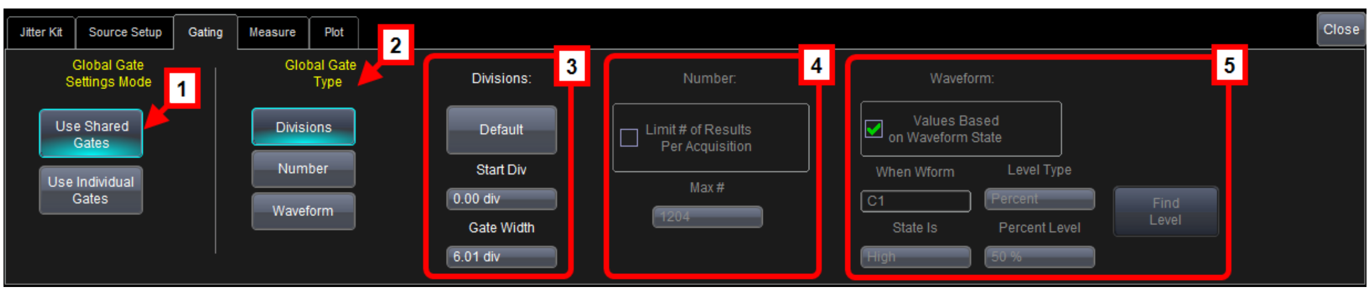
You can define shared gate settings that apply to all measurements or you can define individual gates for each measurement. If you choose to define individual gates, you define the gate settings on the **Measure** dialog for each measurement.

> **Note**: if you apply gating, subsequent jitter domain views will only be applied on measurement values in the gated area.

Jitter Kit Gate Setup

Touch **Analysis → Jitter Kit...** on the menu bar to access the **Jitter Kit** dialog.

Touch the **Gating** tab to access the **Gating** dialog.



Jitter Kit Gating dialog

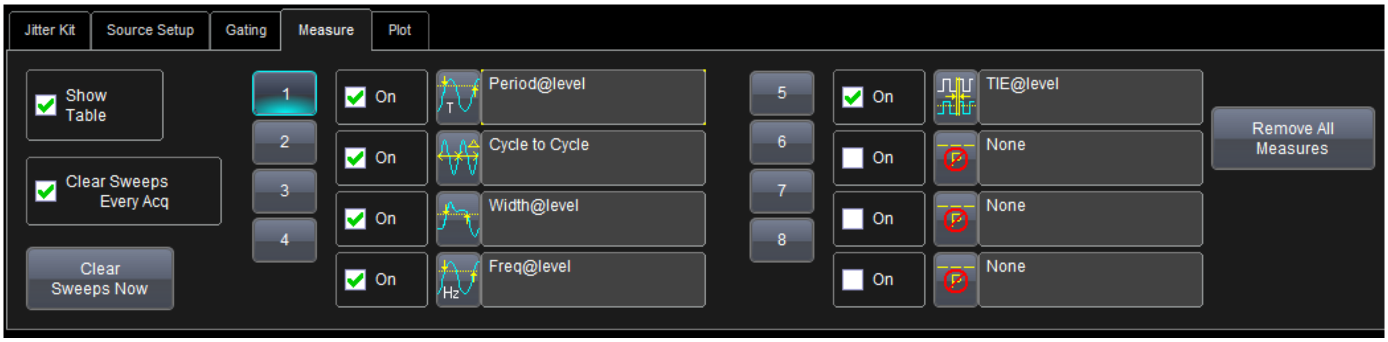
1. Under **Global Gate Settings Mode**, select a mode:
- **Use Shared Gates** - applies the gate settings on this dialog to all measurements.
- **Use Individual Gates** - lets you configure individual gate settings for each measurement. If you choose to configure individual gate settings you can define the gates on the **Measure** dialog.
2. Under **Global Gate Type**, touch **Divisions**, **Number**, or **Waveform**. The corresponding area of the dialog becomes available.
3. If you want to specify gate divisions, in the **Divisions** area of the dialog touch inside the **Start Div** data entry control and enter a value. Touch inside the **Gate Width** data entry control and enter a value.
4. If you want to specify a limit, in the **Number** area of the dialog place a checkmark in the box next to **Limit # of Results per Acquisition**. Touch inside the **Max #** data entry control and enter a maximum value.
5. If you want to specify values based on the waveform state, in the Waveform area of the dialog place a checkmark in the box next to **Values Based on Waveform State**.

Jitter Kit Measure

Selecting your jitter parameter measurements is the first step in performing jitter analysis on your signals.

There are parameter modes for the amplitude and time domains, custom parameter groups, and parameters for jitter testing. You can define measurements on up to 8 waveforms.

The Jitter Parameter list is limited to a subset of all of the measurements available in the scope that are specifically relevant to jitter timing, amplitude or other common measurements used in clock, clock-clock, or clock-data jitter analysis.



Jitter Kit Measure dialog

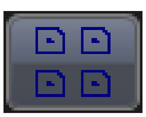
Set up Jitter Measurements

1. Touch **Analysis → Jitter Kit...** on the menu bar.
2. Touch the **Measure** tab to access the **Measure** dialog.
3. Touch the **Show Table** checkbox to display the parameters below the grid.
4. Touch the **Clear Sweeps Every Acq** checkbox to clear data from every sweep (acquisitions).

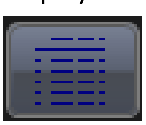
> **Note**: Touch **the Clear Sweeps Now** button to clear data from sweeps (acquisitions) now. During waveform readout, cancels readout.

5. For each parameter touch a number button and touch the **On** checkbox to enable the parameter.
6. Touch the **parameter** button alongside the checkbox.

A pop-up menu of parameters categorized by type appears.
Display only parameter icons by touching the **icon** button at the bottom of the menu.



Display the icons in list form, along with an explanation of each parameter, by touching the **list** button.



Use the **Up/Down** buttons to scroll through the list of icons.

> **Note**: Depending on the measurement parameter you select and whether you are using shared or individual settings, you can define measurement settings in the right hand dialogs that appear to the right of the main dialog. If you are using shared parameter or gate settings, the measurement parameter uses those shared settings as defined on the **Source Setup** and **Gate** dialogs. If you are using individual parameter or gate settings, you can define measurement settings in the right hand dialogs.

Jitter Kit Plot

You define the plot and grid modes on the **Jitter Kit Plot** dialog. You can choose to display any of the following:

- **JitSource1** and **JitSource2** - These traces are replicas of your channels, but they also have the ability to be easily and automatically time synchronized with the Jitter Track (JitTrack). They also provide the convenience of using two inputs of a differential signal to the oscilloscope and having one trace without needing to separately set up a math function to perform this activity.
- **Jitter Histogram** - Histograms allow you to see how a parameter's values are distributed over many measurements. They do this by dividing a range of parameter values into sub-ranges called bins. A count of the number of parameter values (events) that fall within ranges of the bin itself is maintained for each bin. After a process of several thousand events, the bar graph of the count for each bin (its histogram) provides a good understanding of the distribution of values. Histograms generally use the 'x' axis to show a bin's sub-range value, and the 'Y' axis for the count of parameter values within each bin. The leftmost bin with a non-zero count shows the lowest parameter value measurements. The vertically highest bin shows the greatest number of events falling within its sub-range.
- **Jitter Track** - Tracks allow you to understand how a measurement value is varying in time, and to easily time correlate an unusual measurement value(s) with another waveform, which could be your clock or data lines, or something else, like a power supply line or another signal on your board near the clock or data signal. Tracks display a measurement value on the Y-axis and time on the X-axis. When there are thousands of measurement values, it can seem that the Track is a solid trace, but in fact, it is composed of many discrete points. For more information about track views, see Creating a Track View. Jitter Track is different from the normal Track since, by definition, it is displaying jitter values on the Y-axis instead of directly displaying a measurement parameter value..
- **Jitter Spectrum** - The Jitter Spectrum is essentially an FFT of the Jitter Track with additional capability to locate and annotate peak values automatically. It shows the frequency distribution of the jitter with magnitude plotted on the Y-axis and frequency plotted on the X-axis. Oftentimes, high jitter is due to a nearby interfering signal that has a specific frequency characteristics (e.g. a switching power supply with an 80 kHz switching frequency). By viewing the Jitter Spectrum, knowledge can be gained that can lead to the source of a jitter peak.
- **Jitter Overlay** - One of the most basic ways that engineers think of jitter is as a variation in a horizontal clock position that they can view on an oscilloscope display. This can be created by triggering on a rising or falling clock edge, setting the timebase to be ~1 period, and turning on infinite persistence. This simple method of viewing jitter has two significant drawbacks, as follows:
    1. The jitter in the oscilloscopes trigger circuit is included in the persisted display, and this can lead to erroneous conclusions about how much jitter is really present.
    2. It is not possible to view more complex jitter behaviors, such as phase (TIE) or cycle-cycle jitter using this method.

    The Jitter Overlay overcomes these limitations. Using knowledge obtained mathematically from a single long acquisition, it recreates the display described above for any jitter behavior without a contribution of jitter from the oscilloscopes trigger circuitry and. This simple view can quickly and intuitively reveal quite a bit about the circuit behavior

You can also change the grid display (for example, **Auto**, **Single**, **Tandem**, or **Quattro**).

Jitter Kit Plot dialog

Set up Jitter Plot

1. Touch **Analysis → Jitter Kit...** on the menu bar.
2. On the **Plot** dialog, touch the **Measure to Plot** field and choose a measurement.
3. Touch the **Plot Mode** button and select **Jitter** or **Value** for the Plot mode.

Note: You can turn off all of the plots by touching the **Turn Off All Plots** button.

4. Touch one of the **Grid Mode buttons** to change the grid display (for example, **Auto**, **Single**, **Tandem**, or **Quattro**).

PLEASE NOTE THE FOLLOWING:

- Small images label each **Grid Mode** button and indicate its corresponding grid configuration.
- **Autogrid** automatically adds or deletes grids as you select more or fewer waveforms to display.

5. Touch the check box to turn on the plot you want to display (for example, Jitter Histogram, Jitter Spectrum, etc.).

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